April 1955 ARS-52-4

UNITED STATES DEPARTMENT OF AGRICULTURE

Agricultural Research Service

DAIRY CATTLE RESEARCH AT THE IBERIA LIVESTOCK EXPERIMENT STATION *

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Dairy cattle research at the Iberia Livestock Experiment Station, Jeanerette, Louisiana, is being conducted in an effort to develop methods of breeding dairy cattle which will be better adapted to the climatic conditions that prevail in the Gulf Coast region of the United States. These studies are conducted by the Dairy Husbandry Research Branch, Agricultural Research Service, U. S. Department of Agriculture, in cooperation with the Louisiana Agricultural Experiment Station as part of the Cooperative Southern Dairy Cattle Breeding Project. A report of progress to date is presented in these pages.

The experimental herd is made up of purebred Jerseys, purebred Red Sindhis (a milking strain of Zebu cattle from India), and various crosses between the two breeds. In addition, some Holstein and Brown Swiss crosses with Sindhis have recently been included. The composition of the herd is shown in Table 1.

All generations of animals in this project are studied from the standpoint of heat tolerance and physiological characteristics, growth rate and morphological characteristics, milk and butterfat production, and biosociological attributes. Feeding and management conditions are maintained as nearly uniform as possible, so that all animals will have similar opportunities to express their genetic abilities.

Heat Tolerance

Heat tolerance can best be defined as the ability of an animal to maintain normal physiological processes despite increasing environmental temperatures. For example, the upper range of "optimal" environmental temperatures for European breeds of dairy cattle is estimated to be about 80° to 85° F., but some individual cows show no ill effects at somewhat higher ambient temperatures; these latter individuals are said to be more "heat tolerant" than the others. Further, it is assumed (for the present) that the degree of heat tolerance of an animal is inversely proportional to the severity of physiological reaction to a given environmental temperature above the optimal range.

In these studies, body temperatures are used as a measure of heat tolerance. For example, a cow whose body temperature rises from a base level of 101.5° F. to a maximum of 103.0° F. as a result of prolonged exposure to a high environmental temperature is said to be more heat tolerant

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*This is a progress report of the Dairy Cattle Breeding Studies at the Dairy Husbandry Research Branch, Iberia Livestock Experiment Station, Jeanerette, Louisiana.

than one whose body temperature increases to 105.0° F. under similar circumstances. The increase in respiratory rate which is evidenced by cattle subjected to high temperature is also used, occasionally, as a rough estimate of the amount of environmental stress that the animal is subjected to.

Comparative studies of the heat tolerance of the crossbreds and Jerseys are carried out in a climatic chamber in which the animals are exposed, for 6-hour periods, to an environment of 105° F. air temperature and 34 mm. Hg. vapor pressure (92° F. wet bulb temperature). Hourly observations are made of body temperatures and respiration rates, and notes are made of any other indications of severe environmental stress. Heifers are exposed to these conditions at two month intervals, beginning at 8 months of age and ending at 24 months, while older cows are exposed when dry and at 1, 2, 4 and 6 months post-partum. Responses of the individual to the stress are gauged by determining the mean body temperature and respiration rate for the 6-hour period.

Results of these tests so far indicate that Sindhi-Jersey (F_1) crosses respond with lower mean body temperatures and respiration rates than do Jerseys of corresponding ages and levels of production. Further, a correlation is indicated, within both groups, between levels of production and mean body temperature, but none between levels of production and mean respiration rates. These data are summarized in Figures 1 and 2. Other data collected to date suggest that the mean body temperature reactions of heifers are inversely proportional to both age and the amount of Sindhi blood in the cross.

It has been hypothesized that the Zebus have a greater proportion of surface area to body weight (by virture of their comparatively small sizes, large humps, long ears, and large skin folds at the dewlap and navel) than European breeds. If this were so, then the increased surface area would greatly facilitate heat dissipation and might be one factor contributing to the greater heat tolerance of Zebu cattle. To test this hypothesis, the surface areas of 15 lactating Jerseys and 15 lactating F_1 drosses were measured by means of a surface integrator. It was found that the gross areas of the two groups were indeed significantly different, as were the weights and body lengths. When surface areas per pound of body weight were compared, no difference between the groups was detectable. These results would indicate that the greater heat tolerance of the crossbreds is not attributable to differences in surface area.

Studies of the differences between the two groups in respiratory adjustments to hot environments are currently planned. Such items as alkalosis, acid-base balance, respiratory volume and metabolic rates are being considered.

Growth Rate

Growth of the animals is determined by monthly weighing of the individual herd members, and also by measuring the body sizes at 3, 6, 12,

18 months of age, and three months after the first calving. A summary of the weight data is presented in Table 2, wherein it is evident that the 1/4 Sindhis, 1/2 Sindhis (F_1) and 3/4 Sindhis are significantly heavier than the Jerseys and the 1/2 Sindhis (F_2) at birth, and that these differences are maintained at least throughout the first 2 years of life. Further, lactating halfbreeds (F_1) are significantly heavier than Jerseys of comparable stages of lactation.

Body dimensions of the Jerseys and the various crosses are summarized for four age groups in Table 3. The measured characteristics are highly variable, but there are indications of certain significant differences in body size among the various groups. Although the Sindhi-Jersey (F_1) crosses are consistently the tallest (height at withers) of the groups and are usually the deepest (depth of forechest), they fall behind the Jerseys in length (withers to pins) and for the most part, in width of hips. As might be expected, the slope of the rump (not shown in Table 3) increases directly with the amount of Sindhi blood in the animal. What these various characteristics signify will be determined by an analysis of body measurements with respect to milk production.

In addition to the body weight and size studies, the mammary glands of all young heifers are palpated and graded according to the method used by the Dairy Husbandry Research Branch for the study of the relation of the development of the mammary gland in the calf to subsequent milk production. At the present writing, the data gathered are still far too limited to permit analysis, but studies of correlations between palpation grades and subsequent productions will be made when the data are adequate.

Milk Production

To date, 42 Sindhi-Jersey (F_1) crosses have completed one lactation, and 31 have completed two lactations. On the average, these cows produced slightly less milk and butterfat than their Jersey dams (on 305 day, 2X basis), but the range of variation within the crossbreds was considerably greater than within the Jerseys. These data are summarized in Table 4, wherein it is evident that while half the crossbreds outproduced their dams, the poorer producers more than couterbalanced the better cows. Actually, the differences in average milk and butterfat productions between the two groups for each lactation is negligible when the large degree of variation within each group is considered.

Seven of the poorest producing crossbreds were culled after their first lactations, which accounts for the lesser difference (Table 4) between daughters and dams in their second lactations. Upon completing two lactations, 14 more crossbreds were removed because of poor productions, making a total of 21 animals culled. Several others have been removed for other reasons (sickness, sterility, etc.) leaving 17 lactating F_1 crossbreds in the herd. Thirteen of these have completed their third lactations, and these data are summarized in Table 5. While two crossbreds produced less milk than their dams (6 and 18 lb., respectively), the others bettered their dams' milk productions by from 776 to 5,193 lb. milk.

A more detailed comparison of milk and butterfat productions between the two groups is currently in progress. This analysis is concerned with differences between groups attributable to seasonal variations in environmental temperatures during the course of the lactation. These differences will then be compared with observed differences in heat tolerance both within and between the groups.

It is still too early to determine whether the other breed combinations (3/4 Jersey-1/4 Sindhi, 1/4 Jersey-3/4 Sindhi, 1/2 Jersey-1/2 Sindhi (F_2), etc.) will produce more milk or butterfat than their dam. At the present writing, only a few first lactation records of these crosses have been completed.

Biosociology

An investigation into intra-herd relationships was undertaken in an effort to determine whether any gross differences in behavior might exist between the Jerseys and the Sindhi-Jersey crosses which might in some way account for observed differences in heat tolerance. First it was necessary to gain some understanding of the basic behavior patterns within the herd, and it was quickly established that the herd individuals are arranged in a fairly rigid straight line dominance order. The order of dominance was closely related to the ages and weights of the animals ($r = 0.92$ and 0.88, respectively), but had little if any relation to milk production ($r = 0.28$). Further, the order is established at about 3 to 6 months of age, and the individual advances in rank as the older animals are culled. The rigidity of the order tends to minimize the amount of physical fighting within the herd, since most contests go no further than the "threat" stage. When fighting and excitement were induced in some cows during a series of controlled experiments, the data indicated as much as a 5% production decline as a result of the fighting.

With this background, a study of "temperament" and "wildness" is planned for the near future; these characteristics will be investigated with respect to breed differences and milk production.

Summary

A long term research project designed to develop methods of breeding dairy cattle that will be better adapted to the climatic conditions prevailing in the Gulf Coast region of the United States is currently underway at the Iberia Livestock Experiment Station, Jeanerette, Louisiana. This paper reports progress made to date on the project.

Heat tolerance is defined as the ability of an animal to maintain normal physiological processes despite increasing environmental temperatures. Using body temperatures as an estimate of the "degree of normality" of physiological prodesses it is determined that adult Sindhi-Jersey F_1 crossbreds are more heat tolerant than adult purebred Jerseys, while other data collected to date suggest that the degree of heat tolerance in a Sindhi-Jersey crossbred animal is inversely proportional to both the age

and the amount of Sindhi blood in the cross.

Studies are currently under way to determine the physiological or morphological factors underlying the difference in heat tolerance between the two breeds (Red Sindhi and Jersey) and their crossbred progeny. No difference in surface area per pound of body weight was detected between Jerseys and Sindhi-Jersey F_1 crosses, but differences in body weights and various body dimensions are evident. Data gathered so far suggest that with respect to milk and butterfat production, unselected Sindhi-Jersey F_1 crossbred daughters average only negligibly less than their purebred Jersey dams, but that after some degree of selection, the crossbred daughters produced significantly more milk and butterfat than their Jersey dams.

No doubt a combination of physiological and psychological factors are responsible for the greater heat tolerance of one group of animals over another. We need to recognize and understand these factors, both individually and in combination, so as to be able to rationally direct breeding schedules which will produce cows of enhanced production capabilities. However, it must be recognized that studies of this nature involve long periods of time because of the long interval between generations and the large sample size required for conclusive results.

Table 1. Inventory of the females born and the number on hand in the Red Sindhi crossbreeding experiment at Jeanerette (as of December, 1954)

Breed Combination	Number Born	Number on Hand
Jersey	-	44
Red Sindhi	-	4
3/4 Jersey-1/4 Sindhi	27	18
1/2 Jersey-1/2 Sindhi (F_1)	53	27*
1/2 Jersey-1/2 Sindhi (F_2)	13	11
1/4 Jersey-3/4 Sindhi	22	14
5/8 Jersey-3/8 Sindhi	5	5
3/8 Jersey-5/8 Sindhi	4	3
1/8 Jersey-7/8 Sindhi	5	4
Miscellaneous Crosses	21	10

* includes 6 cows sent to this station from Beltsville, Maryland.

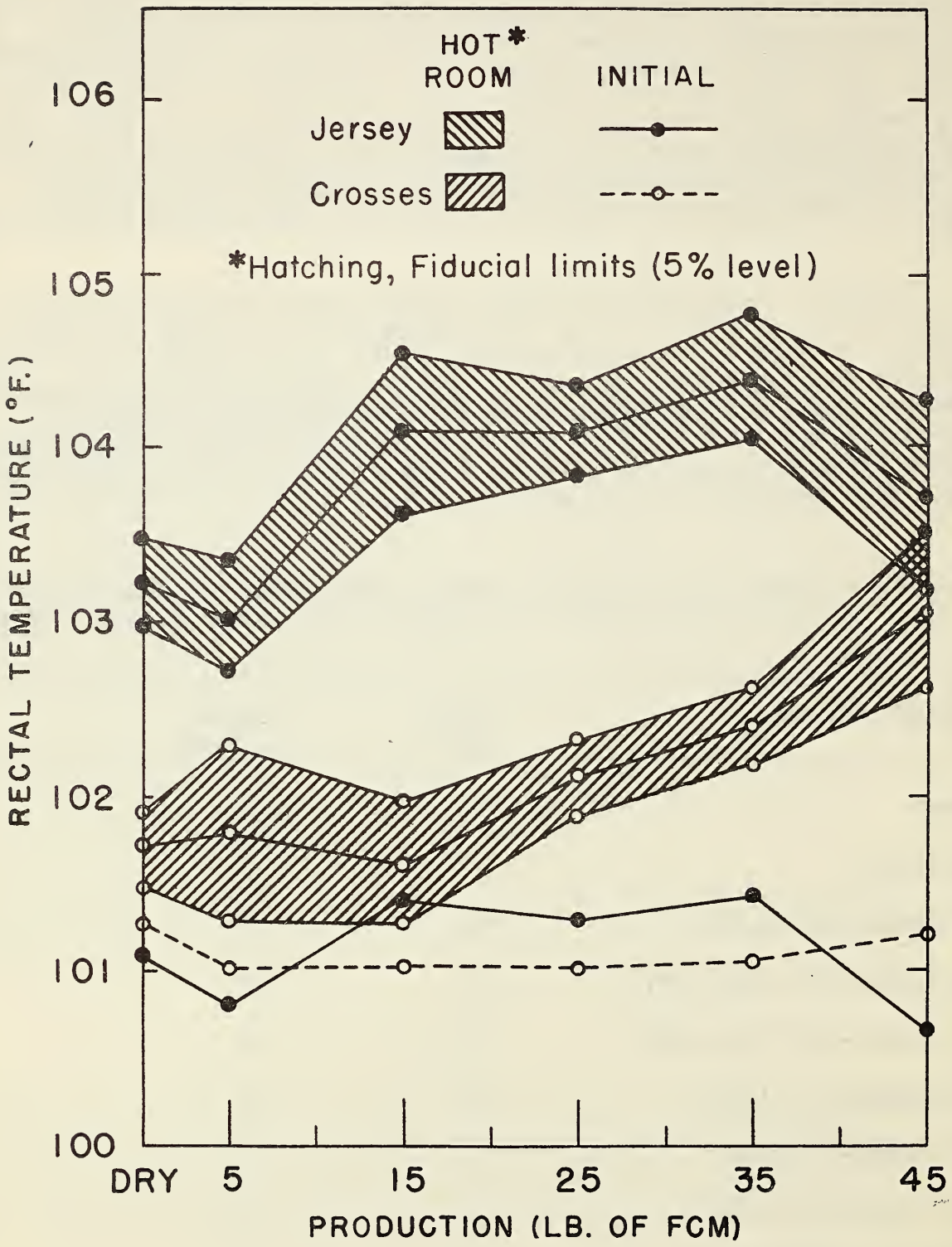

Figure 1. Mean body temperature responses of lactating Jerseys and Sindhi-Jersey (F_1) crosses to standard hot conditions. (6 hrs. at 105° F. with 34 mm. Hg vapor pressure, or 92° F. wet bulb)

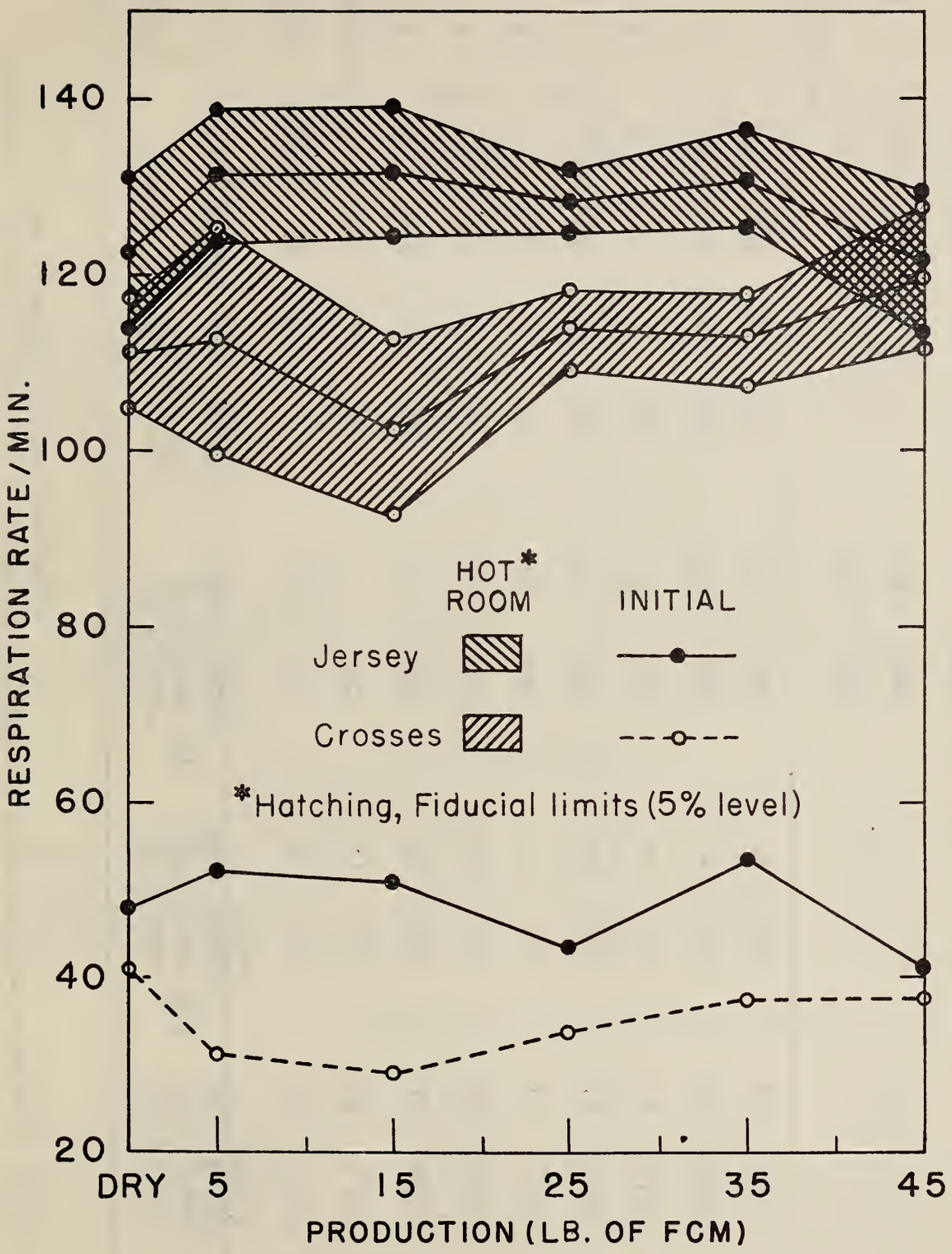

Figure 2. Mean respiratory responses of lactating Jerseys and Sindhi-Jersey (F_1) crosses to standard hot conditions (6 hrs. at 105° F. with 34 mm. Hg vapor pressure or 92° F. wet bulb)

Table 2. Relative growth of Jerseys, Red Sindhis and the various crosses of Sindhi X Jersey as indicated by body weight.

Age	Jersey		3/4 Jersey-1/4 Sindhi		1/2 Sindhi-1/2 Jersey (F_1)		1/2 Sindhi-1/2 Jersey (F_2)		3/4 Sindhi-1/4 Jersey		Red Sindhi	
	No.	Weight (lb.)	No.	Weight (lb.)	No.	Weight (lb.)	No.	Weight (lb.)	No.	Weight (lb.)	No.	Weight (lb.)
Birth	42	53	25	59	51	59	13	53	18	58	4	43
3 months	42	134	23	145	49	140	13	135	18	131	4	111
6 "	43	236	21	246	48	264	13	233	18	232	3	202
9 "	42	289	16	317	48	336	13	306	18	308	3	275
12 "	41	331	16	396	47	406	13	366	14	394	3	359
15 "	39	398	16	451	41	476	12	403	13	472	2	418
18 "	36	463	15	502	44	539	12	468	13	516	3	425
21 "	28	534	15	596	45	592	9	517	13	555	3	469
24 "	28	605	12	672	45	680	9	589	13	643	3	519
Lactation*												
1st	42	670			42	735						
2nd	27	752			32	828						
3rd	13	805			13	854						

* Average body weight during the lactation period.

Table 3. Average values for various body dimensions measured at 6, 12 and 18 months of age and during first lactation period on Jerseys, Sindhis and Sindhi X Jersey crosses.

Breed group	No. of animals	Height at withers (cm.)	Width of hips (cm.)	Circumference of forechest (cm.)	Length withers to pins (cm.)	Depth of forechest (cm.)
		6 Months of Age				
Jerseys	33	91.79	26.34	107.39	83.16	42.27
3/4 Jersey-1/4 Sindhi	17	89.76	25.02	108.39	80.98	41.68
1/2 Jersey-1/2 Sindhi(F_1)	23	92.87	25.73	110.03	81.05	42.97
1/2 Jersey-1/2 Sindhi(F_2)	12	88.44	25.49	107.28	76.94	40.77
1/4 Jersey-3/4 Sindhi	11	89.15	24.63	106.34	74.59	39.45
Sindhi	2	86.50	22.13	99.50	71.63	39.25
		12 Months of Age				
Jerseys	31	102.34	31.65	123.91	95.61	48.41
3/4 Jersey-1/4 Sindhi	14	103.41	34.05	131.19	96.09	51.23
1/2 Jersey-1/2 Sindhi(F_1)	33	103.55	31.69	129.05	93.43	50.02
1/2 Jersey-1/2 Sindhi(F_2)	12	100.77	32.40	130.36	90.73	48.50
1/4 Jersey-3/4 Sindhi	12	102.97	32.79	132.26	90.34	49.80
Sindhi	1	101.00	29.00	124.50	83.50	48.00
		18 Months of Age				
Jerseys	23	110.20	36.74	139.78	106.83	54.85
3/4 Jersey-1/4 Sindhi	11	109.72	37.90	143.35	104.63	54.72
1/2 Jersey-1/2 Sindhi(F_1)	46	111.53	36.13	143.50	102.87	55.16
1/2 Jersey-1/2 Sindhi(F_2)	9	109.09	37.01	141.93	100.76	53.69
1/4 Jersey-3/4 Sindhi	12	111.27	36.99	145.71	99.59	54.39
Sindhi	2	102.08	25.75	131.25	88.88	50.85
		First Lactation (3 months after calving)				
Jerseys	18	119.18	45.17	157.02	120.27	61.59
3/4 Jersey-1/4 Sindhi	9	116.28	43.27	155.50	116.89	60.76
1/2 Jersey-1/2 Sindhi(F_1)	14	120.91	44.31	162.26	114.93	62.41
1/2 Jersey-1/2 Sindhi(F_2)	4	111.93	40.08	148.25	105.33	57.00
1/4 Jersey-3/4 Sindhi	9	117.94	41.28	153.68	110.42	58.86
Sindhi	3	113.40	38.63	154.77	101.32	58.22

Table 4. Average milk and butterfat productions, first and second lactations, of Sindhi-Jersey (F_1) crosses and their Jersey dams.

Group	No. of Animals	Milk Yield			Butterfat Yield				Age		Avg. days
		Avg. (lb.)	Range (lb.)	No. exceeded dams	Avg. (lb.)	Range (lb.)	No. exceeded dams	Avg. (%)	yrs.	mos.	
				First Lactation							
Crossbreds	42	4500	64-9326	21	226	2-437	21	5.02	2	5	255
Jerseys	42	4678	1604-6936		236	78-356		5.04	2	5	300
				Second Lactation							
Crossbreds	31	5582	2035-9677	17	279	92-473	16	5.01	3	6	281
Jerseys	31	5674	2112-8616		280	133-421		4.99	3	8	298

Table 5. Comparative productions of selected crossbred daughters and their dams, third lactation.

Group	No. of Animals	Milk Yield			Butterfat Yield				Age		Avg. days
		Avg. (lb.)	Range (lb.)	No. exceeded dams	Avg. (lb.)	Range (lb.)	No. exceeded dams	Avg. (%)	yrs.	mos.	
Crossbreds	13	7585	5586-9251	11	378	250-473	13	4.98	4	8	303
Jerseys	13	5472	2084-7632		262	121-350		4.79	4	7	285